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Intelligent Transportation

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INTELLIGENT

Danielle Fredette ’12, Assistant Professor of Electrical Engineering, center, introduces students Michael Hayes ’19 and Ryan Gordon ’19 to intelligent transportation design.

TRANSPORTATION

BY MICHELE (CUMMINGS) SOLOMON '91

It wasn't too long ago that self-driving cars seemed like something straight out of an episode of the 1960s Saturday morning cartoon show *The Jetsons*. But childhood fiction is quickly becoming grown-up fact, and a Cedarville professor is driving research that may accelerate the development of these cars of our future.

Danielle (Scarpone) Fredette '12 knew from the time she was very young that she wanted to pursue a science or technology career. "I loved to discover how things worked and how they could work better," she said. "When I discovered that engineers were the ones who made things work, I knew that was the field for me."

She took that passion for discovery to Cedarville University, where she earned a Bachelor of Science in Electrical Engineering. At Cedarville, her professors fueled her excitement for learning. "My professors created a safe place to learn," Fredette explained. "They never made me feel like something was too difficult for me or my classmates to understand or master. They also made it clear that learning hard things would require significant discipline."

AUTONOMOUS AUTOMOBILES

Following graduation from Cedarville, Fredette attended The Ohio State University, where she pursued both master's and doctoral degrees.

Her advisor at Ohio State was working on intelligent transportation design, so this became the focus of her graduate research, specifically on how computers can be used to find a safer, more fuel-efficient way to drive. For her doctoral dissertation, her research focused on how a group of vehicles traveling together can drive more efficiently. She examined what factors could lead to the greatest savings in fuel: position of the vehicles within the group, closeness to other vehicles, and speed.

For example, we know that ducklings swim in a line behind their mother because it saves energy, making it easier for them to swim; Fredette's research applied that same principle to vehicles driving in multiple lanes on the highway. "Imagine a fleet of trucks driving together," Fredette said. "Is there a way that each vehicle can interact on the road that will help save fuel for the group? We know that trucks can save fuel by convoying, or driving closely together in a line, which mitigates the negative effects of air drag. But what other behavioral possibilities are there? That's what I wanted to discover."

So how does Fredette's research relate to the next generation of autonomous vehicles? "Some of the fuel-saving maneuvers we've come up with — extremely close convoying, for example — are either difficult or unsafe for a driver to execute with the necessary precision," she explained. "Computer 'drivers' may not be comparable to human drivers in analytical skill, but they are superior

in reaction time, so the possibility of a computer controlled car opens up a lot of options for fuel-saving behavior."

But with the possibilities, she recognizes there will be bumps along the road. "The more I learn, the more I see how many challenges are still ahead of us to realize fully autonomous vehicles," she explained. "In urban settings there are so many factors to consider — traffic, weather, the unexpected actions of pedestrians — that it becomes extremely difficult without large-scale changes to our infrastructure. But there are still plenty of things we can do today to make our cars safer and more efficient. And our students will have lots of fun and useful problems to solve in transportation for many years."

"It's exciting to learn from an individual who is paving the way in this revolutionary field. It's just another thing that is setting my Cedarville experience apart." – Michael Hayes '19

SUPERMILEAGE CHALLENGE

Fredette joined the faculty of Cedarville's School of Engineering and Computer Science shortly before completing her Ph.D. For her, it was the best of both worlds. "I didn't want to do just straight-up research and development," she said. "Teaching gives me the opportunity to still focus on scholarship while working with people. I love working with the students, teaching them, watching them learn."

Robert Chasnov, Dean of the School of Engineering and Computer Science, is excited to have Fredette back at Cedarville. "Danielle's Ph.D. research is part of the cutting-edge technology being developed for the automotive industry as they consider driverless vehicles," he explained. "We are fortunate to have her."

And he isn't the only one glad Fredette parked at Cedarville. When a group of students heard about Fredette's research in intelligent transportation design, they asked her to work with them on their senior design project next year. The team of students will take a retired vehicle from Cedarville's Supermileage fleet — cars entered in the Shell Eco-Marathon national competition to improve fuel efficiency — and attempt to make it an autonomous vehicle. This is in preparation for a new autonomous category in the Shell Eco-Marathon national competition.

Students are excited about the unique research background Fredette will bring to the team. "I am thrilled with the opportunity to learn from Dr. Fredette," said Michael Hayes '19, one of the senior design team members. "It's exciting to learn from an individual who is paving the way in this revolutionary field. It's just another thing that is setting my Cedarville experience apart."

Fellow team member Ryan Gordon '19 added, "Working with Dr. Fredette will allow us to bring recent research to our senior design project. It's really exciting."

Students will benefit not only from Fredette's knowledge, but her heartfelt interest for the subject as well. "Danielle's enthusiasm will keep her students engaged during the more mundane aspects of the project in order to complete a truly exciting result," said Chasnov.

TEACHING RESEARCH

It's exactly that kind of passion that Fredette hopes to pass on to her students. "I hope to help them see that research can be exciting," she said. "Since the students seem to be interested in what I've been researching, I hope to use that point of connection to make them more aware of what research is and what their lives might be like if they choose to pursue a research-heavy career, whether in industry or in academia."

For Fredette, collaborating with students on research is a win-win: She gets to publish and her students gain valuable lessons on how to conduct effective research and why it's important for developing new technology. "Attempting to answer a question that I really believe is relevant to a person or technology makes me passionate about research, and I love being able to impart some of that to my students," she explained.

And who knows where her research will lead. "I'm looking forward to spending this summer answering a couple of technological and mathematical questions that I've had in the back of my mind for a while," she said. Whether her investigation applies to cars of the future or finds application in one of her engineering courses, Fredette will continue to seek cutting-edge answers to practical problems, firmly in the driver's seat as her students race toward the future.

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